Impact of Fe(II) concentration and pH on transformation of As/Sb bearing jarosite

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Jarosite is a common mineral in acid mind drainage and acid-sulfate soils and can be an important host phase for As[1] and Sb[2]. These toxic metalloids may be released by reductive dissolution of jarosite; a process which also liberates Fe(II) [1]. Previous research suggests that, under circum-neutral conditions, Fe(II) can catalyse the rapid transformation of jarosite to more stable Fe(III)-bearing minerals, such as goethite. In this study, we addressed the hypothesis that the Fe(II)-catalysed transformation of jarosite can significantly alter the mobilization and bioavailability [1] of Sb and As by changing their speciation or absorbtion sites during the mineral transformation process [3].

Our approach involved subjecting As(V)/Sb(V)-bearing jarosite to a range of aqueous Fe(II) concentrations (0.5 to 20 Mm) for 24 h under anoxic conditions at pH 7. We monitored aqueous chemistry while changes in the solid-phase speciation of As, Sb and Fe were tracked over time via X-ray absorption spectroscopy (XAS). At higher concentrations of Fe(II) (5 to 20 mM) 58- 65% of jarosite transformed to goethite within 24 h, while at lower concentrations (0.5-1 mM Fe) the dominant final Fe(III) mineral was lepidocrocite. We also found that at higher concentrations of Fe(II), a green rust intermediary formed within 10 min of subjecting of jarosite to Fe(II). Green rust remained the dominant Fe mineral up to 8 h in 20 mM Fe(II) treatments. As k-edge XANES spectroscopy revealed some reduction of As(V) to As(III) occurred in the presence of higher concentrations of Fe(II) (10 and 20 mM). In contrast, Sb L-edge XANES spectroscopy revealed neglible reduction of S(V) over the course of this experiment.

[1]Johnston, S.G., et al., Arsenic mobilization in a seawater inundated acid sulfate soil. *Environmental Science and Technology*, 2010. **44**(**6**): p. 1968-1973.[2]Tighe, M., et al., The availability and mobility of arsenic and antimony in an acid sulfate soil pasture system. *Science of The Total Environment*, 2013. **463**–**464**(**0**): p. 151-160 [3]Amstaetter, K., T. Borch, and A. Kappler, Influence of humic acid imposed changes of ferrihydrite aggregation on microbial Fe(III) reduction. *Geochimica et Cosmchimica Acta*, 2012. **85**: p. 326–341.